

Geant4 Users Workshop, Catania, 16 October 2009

Geant4 physics performance: discussion on open issues

A.Ribon

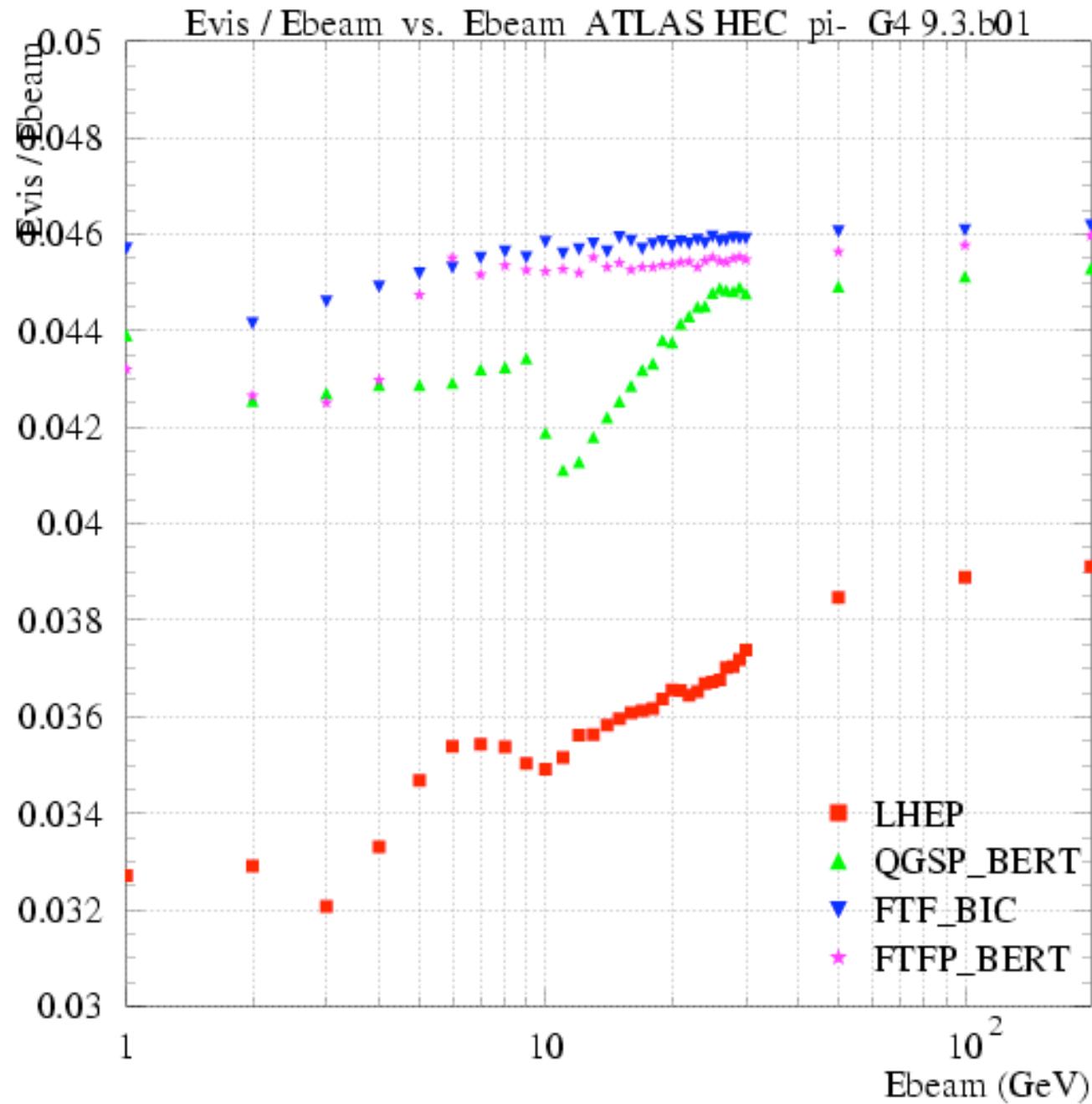
CERN PH/SFT

Geant4 hadronic issues in HEP

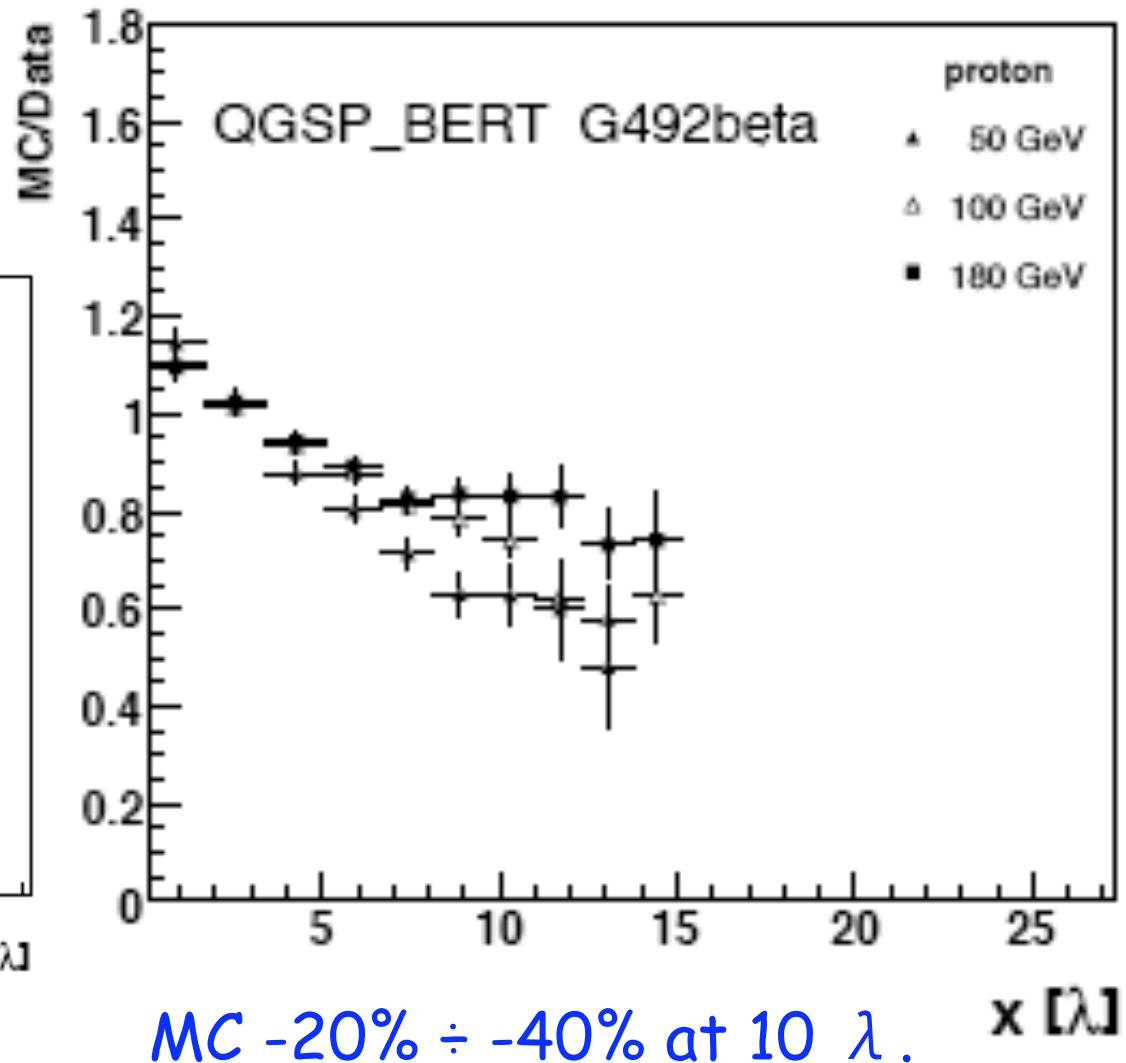
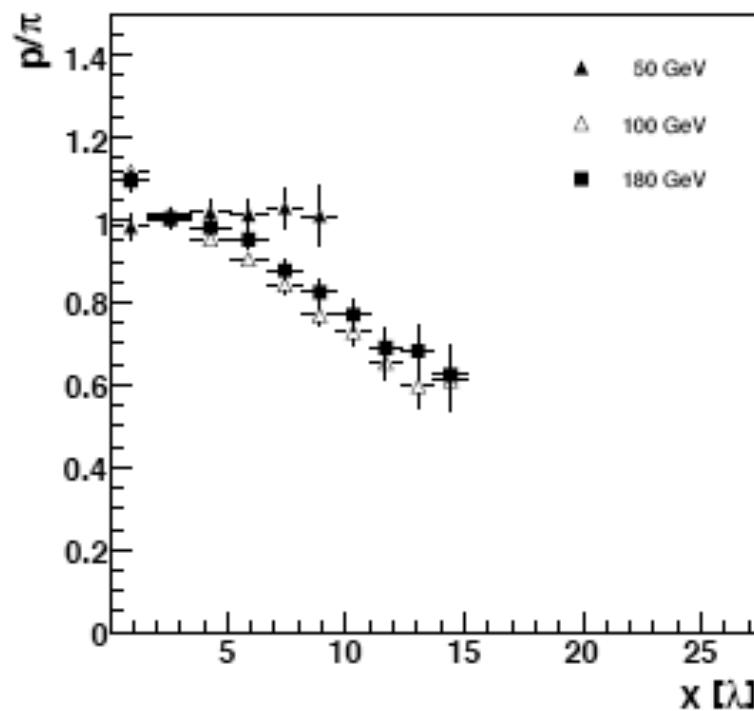
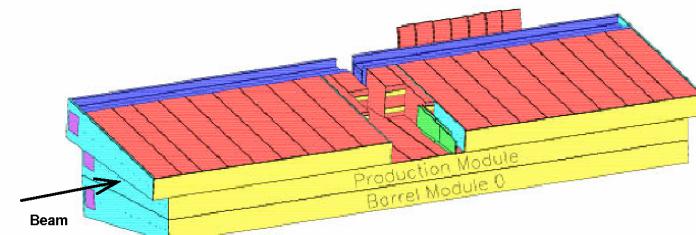
- 1) Discontinuities in some calorimeter observables as a function of the beam energy, due to the transition between hadronic models
 - It can affect the simulation of jets
 - It can affect the hadronic calibration of ATLAS calorimeters
- 2) Proton longitudinal shower profiles are shorter than data in QGS-based Physics Lists, due to diffraction
 - It can affect the simulation of jets
- 3) Lateral shower profiles are a bit narrower than data
 - Probably not a big issue for LHC experiments, but for ILC it could be a serious problem (very granular calorimeters)
- 4) Pion longitudinal shower profiles still a bit too short
- 5) Energy resolution a bit too good in simulation
- 6) Energy response a few % too high in simulation
- 7) Kaon inelastic interactions?
 - It can be important for LHCb tracker

See J.M.Quesada talk

Energy response
in a simplified
Cu-LAr
calorimeter

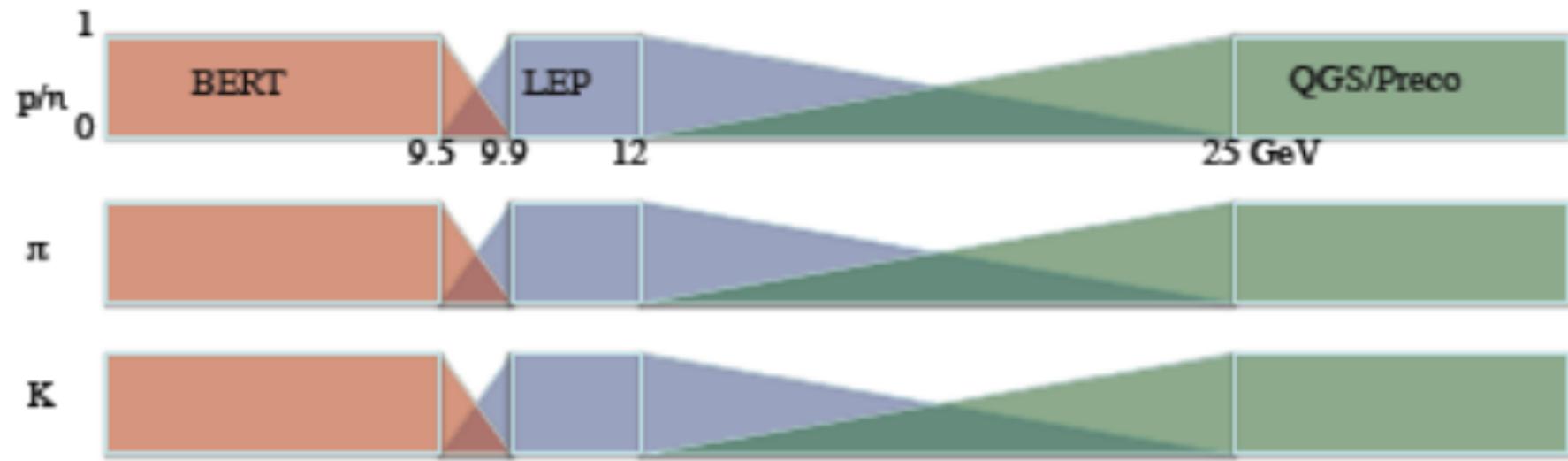


Proton longitudinal shower profile in stand-alone ATLAS TileCal test-beam at 90°



See M. Simonyan talk

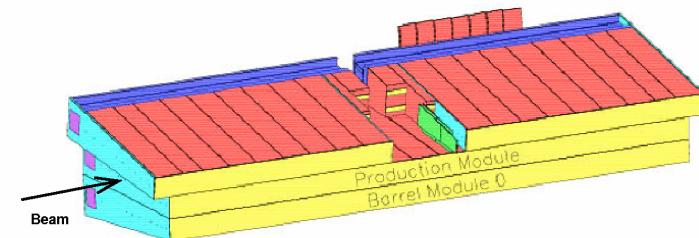
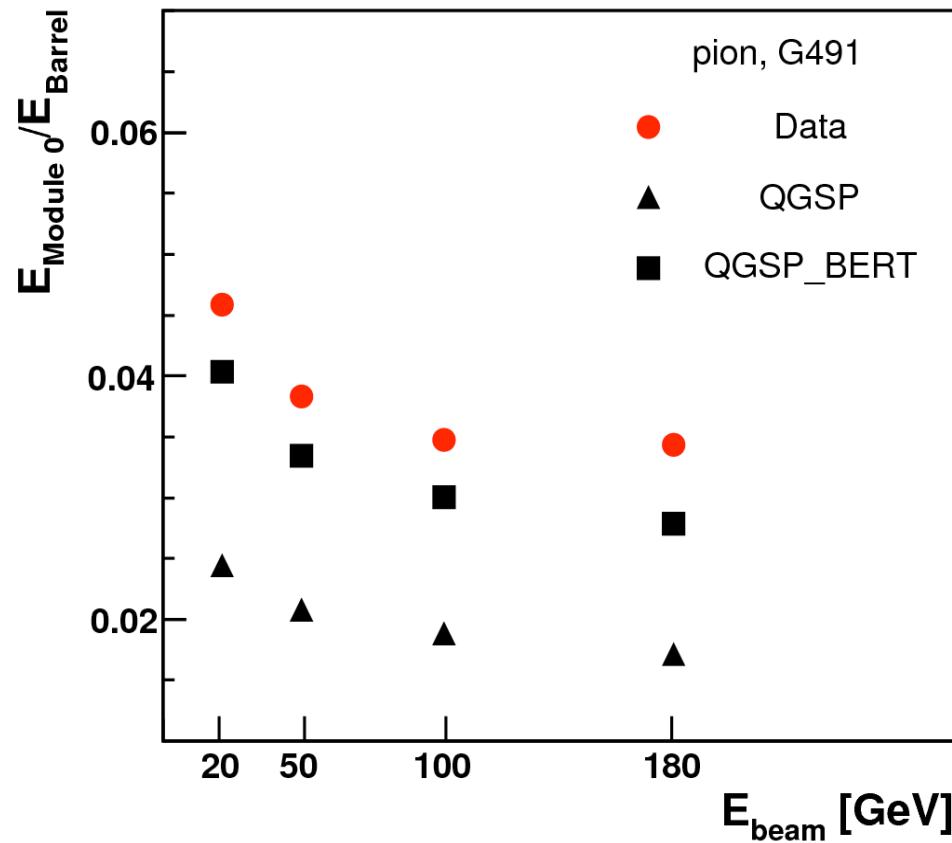
QGSP_BERT Physics List



General problem of transition between:

- High-energy : string models
- Intermediate/low energy : cascade models

Pion lateral spread in stand-alone ATLAS TileCal test-beam @90°

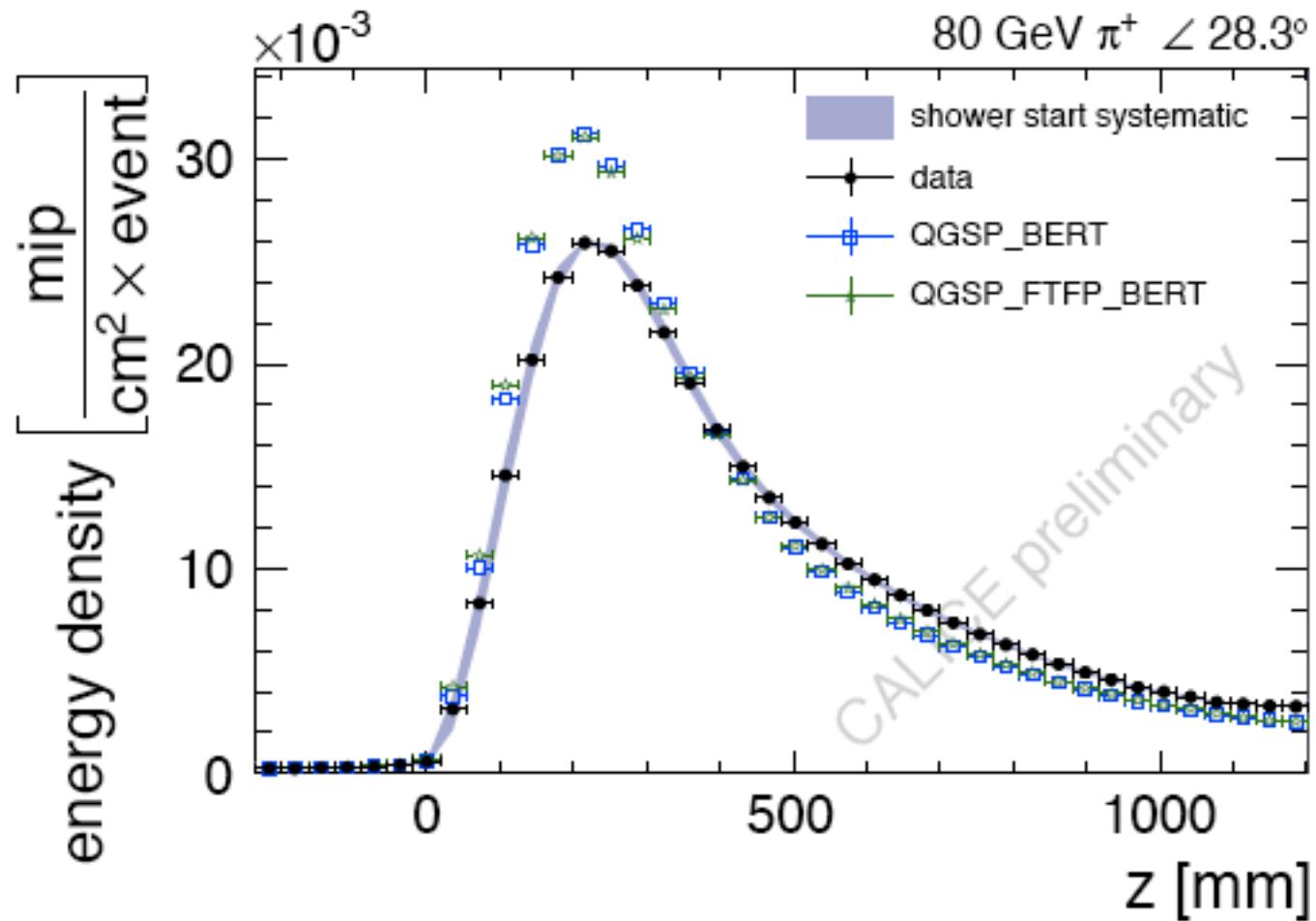


Bertini cascade makes shower wider, which is in better agreement with data, but data are still a bit wider.

See M. Simonyan talk

See CALICE talk by B. Lutz

Longitudinal Profiles – Measurement and Simulation



Geant4 electromagnetic potential issues

1) Multiple scattering

- Does the recent tuning affect LHC observables?

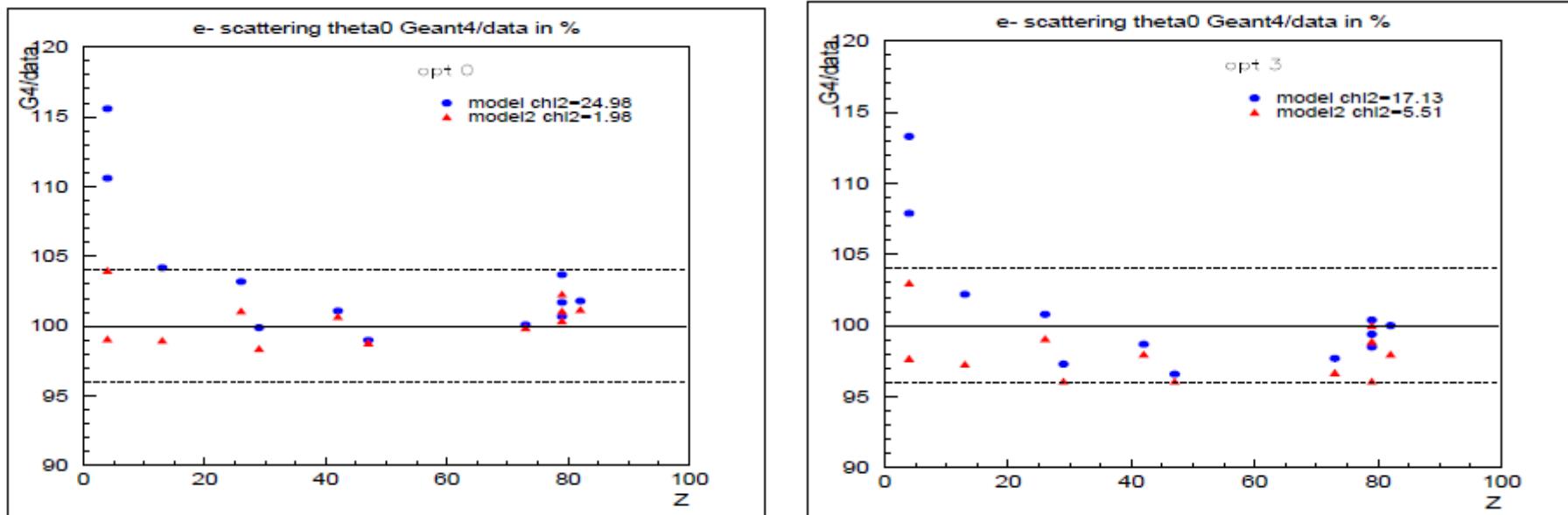
2) Energy deposition in thin silicon layer at low-p

- $\approx 5\%$ deviation at low $\beta\gamma$: does it matter?
- $\approx 3\%$ variation of peak position vs range cut: does it matter?

3) EM physics tables

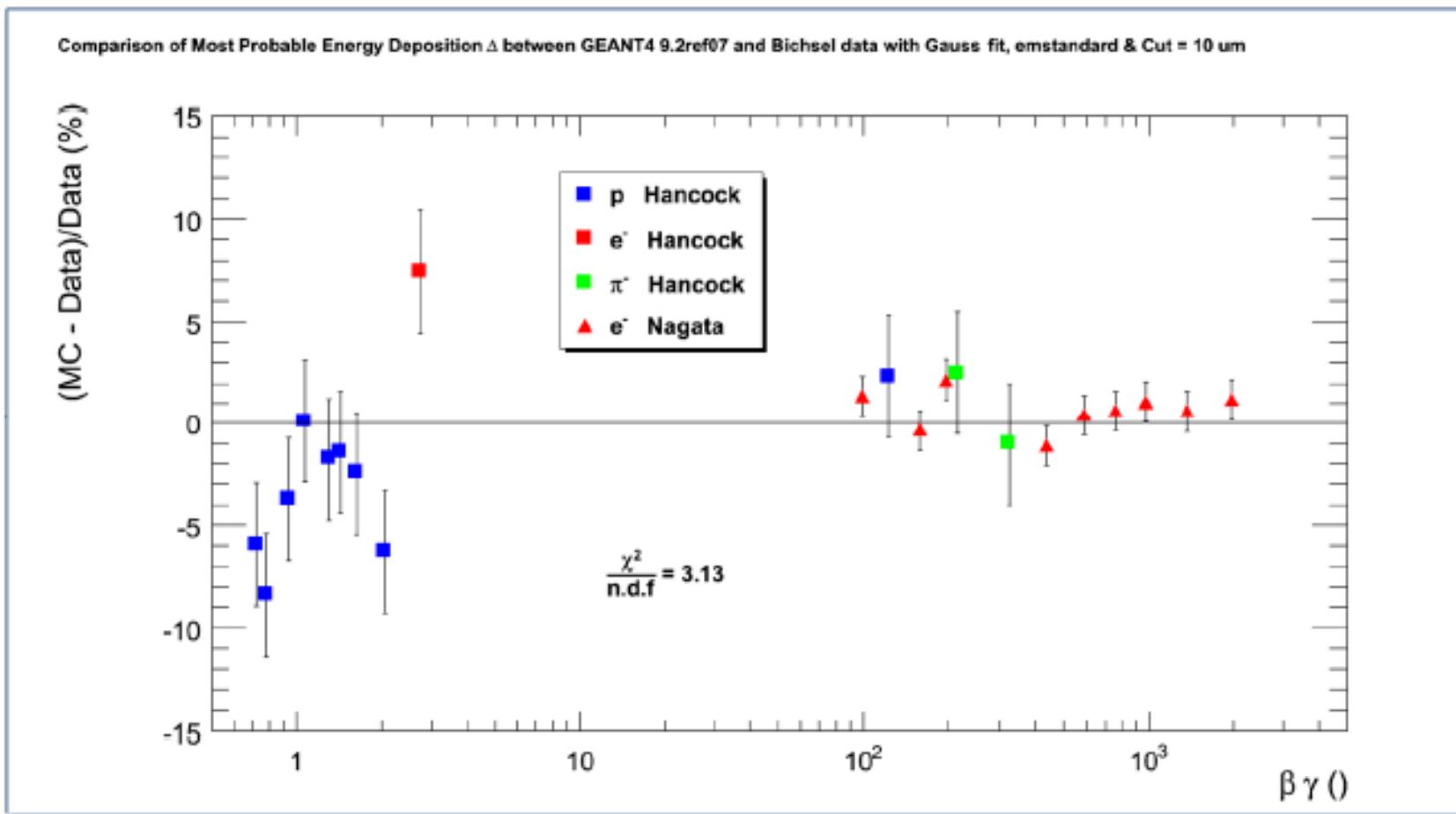
- Simplification of tables in the range 1 keV - 10 TeV : is it ok?

Multiple scattering model (msc) developments



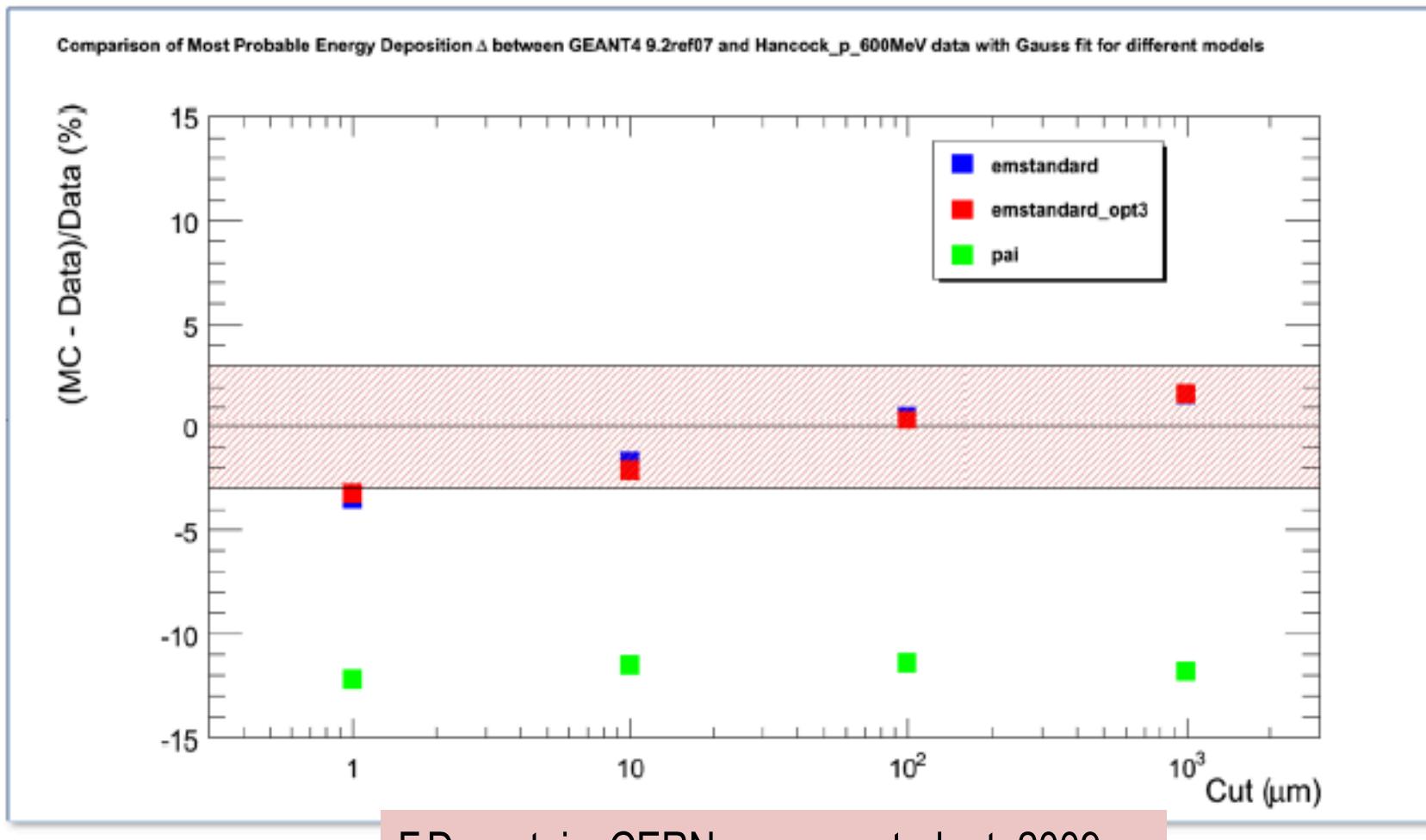
- New electron msc benchmark results recently published
B.A.Faddegon et. al., Phys.Med.biol. 54 (2009) 6151
- Tuning of the Urban model – G4UrbanMscModel2
- New G4GoudsmitSaundersonMscModel (O.Kadri) – similar principals as Penelope and EGSnrs msc models, still needs more validation

Recent validation of Geant4 simulation of response of thin (300 um) Silicon detector



F.Dupertuis, CERN summer student, 2009

Problem in simulation of response of thin Si detector for 600 MeV proton beam: cut dependence of peak position



F.Dupertuis, CERN summer student, 2009

Improvements of initialisation for standard EM physics for Geant4 9.3

**CPU for initialisation of EM
standard physics for setup
with 289 materials**

Geant4 version	amd 32- bit	amd 64-bit
G4 9.2	147 s	179 s
G4 9.3	51 s	56 s

- Proposed g4 9.3 default energy interval **1 keV-10 TeV**
- Number of bins 70 (~20% memory saving)

- Revised of physics vector classes (A.Bagulya, G.Cosmo, V.Ivanchenko)
- Revised convertor of cut in range to production thresholds (H.Kurashige)
- Cleaned up standard EM initialisation (V.Ivanchenko)